



# Market and Applications Development

## TECHNOLOGY CENTER IN SWITZERLAND

CBMM Technology Suisse is the company's subsidiary responsible for managing projects related to developing new niobium applications, markets and products. The subsidiary also plans and executes the niobium technical program. A key activity is the development of projects tailored to the needs of CBMM customers, providing specialized technical support on a project-by-project basis.

CBMM counts on a team of professionals who are specialists in applications in the structural, automotive, oil & gas, stainless chemical and energy storage sectors.

The following items describe the main projects developed in partnership with institutions and customers during 2017:

### Niobium in vehicle bodies

Press hardening (PH) steels are used in car bodies to increase safety, while also decreasing the vehicle weight, thereby lowering fuel consumption and greenhouse gas emissions. Originally, the composition of PH steels did not contain niobium, but it was found that adding up to 0,06% niobium during the fabrication of these materials, attractive benefits resulted, like improved formability, toughness and deformation capacity. These benefits enable the production of PH steels with higher mechanical strength, permitting carmakers to lower vehicle weight by up to 20% without sacrificing crash worthiness.

The new composition of PH steels started to be used in China in 2017. A leading Chinese carmaker, FAW, is applying these steels in the fabrication of vehicle components.

Several CBMM customers already have PH steels containing niobium in their product portfolios and are qualifying those products with car makers. General Motors has approved the material and will apply it in the United States, initially. Hyundai Motors, in South Korea, is on course to include these steels in the company's 2020-year vehicle models.

PH steels with niobium are also being applied in truck cabins by Scania in Sweden. Other developments include the use of these steels in the structures of cargo trucks, seeking to build lighter yet stronger components.

### Niobium in truck beds

Chinese truck manufacturer Juntun is aggressively applying the lightweighting concept - 31.000 cargo trucks have already been fabricated using the concept in truck bodies. The vehicles are two tonnes lighter thanks to the leaner structures, which increases payload capacity by a corresponding amount. Due to the higher strength of the steel, and its improved toughness, attributes that result from the use of niobium, the vehicles require fewer maintenance stops, which contributes to higher productivity.

In 2017 Rossetti launched a new series of road implements called Niobium Line. These products are constructed of high strength niobium microalloyed steels.

By using these steels, it was possible to eliminate 80% of the reinforcements in the beds of the implements, resulting in lighter, more economical products. Rossetti had already successfully applied the concept in dump trucks used in the mining industry.

### Niobium in exhaust systems

Together with a South Korean partner, CBMM developed a low-cost steel to meet the needs of Chinese automakers. Known as AISI 409L, the steel containing niobium was approved for use in exhaust systems after having been shown to meet specifications related to corrosion and thermal resistance, as well as processing properties such as stampability and weldability. This customer had attempted to qualify the material for two years in the Chinese market, but only achieved success with the addition of 0,1% niobium.

### Niobium in aluminum wheels and cylinder heads

Even at levels as low as 0,1%, niobium has been shown to be an excellent grain refiner in cast aluminum alloys with silicon levels above 7% for applications like wheels and cylinders heads. The results have reproducibility and demonstrate an unparalleled effect in refining the grains of the alloys in question. In 2018 several automakers will begin the qualification process.

### **The potential of niobium in batteries**

Warwick University in the United Kingdom is studying the development of lithium-ion batteries with high density cathodes containing niobium. The project aims to develop understanding around the benefits of niobium in these components, as well as partnerships to address the potential of the new technology.

### **Niobium increases the service life of disk brakes**

Disk brakes made of gray cast iron containing niobium showed a 75% increase in the service life of the components. Brazilian manufacturer WHB made the parts, adding 0,21% niobium to the material. Samples of the disk brakes are being tested at Volkswagen in Germany as part of the company's qualification process.

### **Steel coil with niobium for pipelines**

A niobium microalloyed steel was produced in a continuous caster. Normally, a plate rolling mill is used to make materials with a thickness of 20 millimeters. The material resulting from the continuous caster is sold in the form of coil and is already being applied in the construction of oil and gas pipelines in China. Coil has higher productivity and lower costs compared to plate, giving it important competitive advantages, especially in pipelines that require higher gauges.

The steel is being used on the Shanjing Fourth Line and in part of the pipeline that connects Russia to eastern China.

### **Niobium in low cost construction steels**

Asian companies approved the concept of partially substituting manganese with niobium to reduce the manufacturing costs of structural steels. Steelmakers in China involved with the project concluded that it is possible to reach cost savings of up to US\$5 per tonne of steel. The concept is being applied in structural steels with strength below 355 MPa.

The use of 0,01% niobium enables the substitution of up to 0,5% manganese without altering the mechanical properties of the material. In India the concept is being applied to substitute manganese and vanadium as a way to reduce production costs.

### **FeNb B86 – developing a new product**

A new CBMM product, FeNb B86, was approved following tests at several steelmakers in China and Brazil who produce steel for rebar used in the construction industry. FeNb B86 is a briquette that contains nearly 40% niobium and a higher level of phosphorous than other CBMM products. The new product is manufactured as a sub-product of the standard ferroniobium industrialization process. The price point of FeNb B86 is lower than standard ferroniobium, and it can be used

in less sophisticated steels, like those for rebar. FeNb B86 was created in response to the need of rebar producers to reduce costs in the face of a competitive global price environment.

### **MicroSim: simulation software approved by steelmakers**

CBMM developed a program called MicroSim to optimize and simulate hot rolling. Several steelmakers have successfully used the software program that allows them to predict, based on the chemical composition and processing conditions, the final properties of the steel. This accelerates production improvements as it permits quick simulations of different conditions and the comparison between them, facilitating the identification of the most efficient routes. In addition to increasing productivity, companies have been able to produce better quality products that meet specifications and have improved mechanical properties. The software program has been well received by Chinese, North American and South Korean steelmakers.

## KEY ROUNDTABLES ORGANIZED BY CBMM - 2017

TITLE	OBJECTIVE	PARTICIPANTS
Lithium-Ion Battery Panel	Discuss the current state of development of lithium-ion batteries and the possibility of applying niobium compounds in their composition	Representatives from CBMM, Avicenne Energy, WildCat, Münster University, Senai and UFMG
Keppel Marine Workshop	Discuss niobium microalloyed steels for offshore applications	Representatives from CBMM and Keppel
Formula E Workshop	Present the concept of niobium as a grain refiner in cast silicon-aluminum alloys and discuss possible applications	Nissan, Granger Worrall, McLaren, Formula E

## PARTICIPATION IN KEY TECHNICAL EVENTS - 2017

TITLE	OBJECTIVE	PARTICIPANTS
AISTech 2017	The Association for Iron and Steel Technology (AIST) is the leading steel sector professional organization. It promotes information exchange, new technologies and innovation. AISTech is the largest steel-related conference in the world and is held annually in the United States. In 2017 CBMM presented papers on the use of niobium as a solution for engineering challenges.	Global steel production chain
SEAISI 2017	Present technical papers to the steelmaking and end user community of Southeast Asia to promote the exchange of experiences related to fabricating niobium microalloyed steels.	Southeast Asian steel chain
Formula E	By sponsoring Formula E, CBMM has an opportunity to work in partnership with the main players of the electric vehicle chain to promote niobium technology and its important contribution to a more sustainable world. Formula E is a competitive platform to develop and test technologies to refine the design and functionality of electric car components and accelerate the transition to the use of clean transport on a global scale.	Formula E teams, important automotive manufacturers and suppliers, international organizations (FIA, UN)
ABM Week 2017	Present diverse technical papers from different segments, promoting the increased use of new steel processing technologies, especially those related to niobium microalloyed steels. Discuss technical aspects of the application of niobium with visitors to CBMM's booth.	Brazilian steel sector

## KEY PAPERS PUBLISHED BY THE CBMM TEAM - 2017

TITLE	AUTHORS	CONFERENCE
Impact of Alloying Design of Traditional 22MnB5 on the Crash Relevant Properties of Press Hardened Components	Bian Jian, Sujoy S. Hazra	Conference Proceedings of AHSS Intl. Conference 2017
Optimization and Stability of Production of Heavy Gauge EH 47 Ship Plate	Doug Stalheim	SEASI 2017
The value of High Strength Steels, Enabling Low Carbon Energy Technologies: Offshore Wind Farms	Jitendra Patel	SEASI 2017
Optimized Cost-Effective Production of Structural Hot-Rolled CSP Coils Through Proper Austenite Conditioning	Pello Uranga, Nerea Isasti, Jose M. Rodriguez-Ibabe, Douglas G. Stalheim, Vance Kendrick, Brian Frye, Marcelo Rebellato	AISTech 2017
Computational Investigation of the Impact of the Thermo-mechanical Parameters on the Austenite Microstructure Evolution of Some Niobium Microalloyed Steel Grades in the Hot Strip Mill Process of CSN	Felipe Bastos, Marcelo Rebellato	ABM week 2017